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Concurrent validity of the 1994 Strong Interest Inventory: A comparison of criterion groups by gender

by

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ABSTRACT

Studied the concurrent validity of the Personal Style Scales, General Occupational Themes, and Basic Interest Scales of the 1994 Strong Interest Inventory for three participant groups: combined-sex, women, and men. Groups represented 43 occupations, with equal numbers of employed women and men in each group, for a total of 17,165 participants selected from the General Reference Sample (Strong Interest Inventory Applications and Technical Guide; Harmon, Hansen, Borgen, & Hammer, 1994). Univariate and multivariate techniques were used to examine the capacity of the predictor sets to identify occupational group membership and to determine whether identification was more accurate for one sex than the other. Effect sizes and direct hit rates were reported to indicate occupational group differentiation for each of the 35 scales across all three participant groups. The statistical indices were also reported for the three predictors sets, the Personal Style Scales, General Occupational Themes, and Basic Interest Scales, across the three groups. The three predictor sets showed nearly equivalent concurrent validity for the combined-sex, women's, and men's samples. The Basic Interest Scales were found to be the most powerful predictor set, showing a higher hit rate for men than women, but no difference across participant groups in terms of variance accounted for. The Personal Style Scales and Basic Interest Scales accounted for

more occupational group variance in the women's sample than in either the men's or combined-sex samples. Combining the Personal Style Scales with the General Occupational Themes and Basic Interest Scales resulted in modest increases in hit rates and variance explained across all three participant groups, but the Basic Interest Scales formed the most powerful set for predicting occupational group membership in the multivariate environment. The implications of the results for vocational counseling were discussed.

INTRODUCTION

No step in life, unless it may be the choice of a husband or wife, is more important than the choice of a vocation.
- Frank Parsons (1909)

The significance of vocational interests is now widely recognized by both education and industry, but Parsons (1909) was the first to write on the topic. He observed vocational adjustment resulted from agreement between characteristics of the person and those of the occupation. The need for a means by which to assess those characteristics was amply illustrated a few short years later as the United States military attempted to assign vast numbers of recruits to the service occupations in which they could best support the nation's efforts in World War I. Formal methods of assessing vocational interests followed therefrom.

Numerous researchers have worked diligently over the decades to develop measures of vocational interests. One of the most enduring and widely used instruments for this purpose is E. K. Strong's (1927) test, first published as the Vocational Interest Blank (SVIB). Strong believed work in interest measurement should be empirically based and periodically updated (Harmon, Hansen, Borgen, & Hammer, 1994). Since publication of the first version of the SVIB, the measure has undergone numerous revisions, a testimony to the commitment of Strong and his successors and of the publisher to ongoing evaluation and improvement of the instrument.

The following summarizes revisions of the Strong, then reviews validity studies of previous editions, and studies of women's vocational interest measurement. It then examines the concurrent validity of the most recent revision, the Strong Interest Inventory (SII; Hansen et al., 1994), and compares the measure's capacity to accurately identify occupational group membership for women and men.

REVIEW OF THE LITERATURE

Evolution of the Strong

The following summarizes the revision history of what is currently known as the Strong Interest Inventory (Harmon et al., 1994).

E. K. Strong first introduced the instrument, named the Strong Vocational Interest Blank (SVIB), in 1927. This form was intended for use with men and was followed by publication of a women's form in 1933 (Strong, 1933). Over the next four decades, the SVIB continued to be published in separate forms. For a brief period, the men's test booklets were printed on blue paper (Campbell, 1966) and the women's on pink paper (Campbell, 1969). The Strong was revised twice, the men's form in 1938 (Strong, 1938) and 1966 (Campbell, 1966) and the women's in 1946 (Strong, 1946) and 1969 (Campbell, 1969). The Basic Interest Scales (BIS; Campbell, Borgen, Eastes, Johannson, & Peterson, 1968) were added in 1969 to the women's revision and to a new profile for men (Campbell, 1973).

In response to a growing awareness of sex bias in interest measurement (e.g., AMEG Commission on Sex Bias in Measurement, 1973; Harmon, 1973b), the 1974 revision (Campbell, 1974) introduced a merged sex form and eliminated the blue and pink test booklets. The name was changed to the Strong Vocational Interest Blank - Strong-Campbell Interest Inventory (SVIB-SCII or SCII), reflecting David Campbell's

role in its continual refinement following the death of E. K. Strong in 1963. The 1974 SCII introduced the General Occupational Themes (GOT) as well, thereby employing Holland's theory (1973) of interest types to provide a global view of an individual's interests both within and beyond vocational concerns.

The next two revisions emerged in 1981 (Campbell & Hansen, 1981) and 1985 (Hansen & Campbell, 1985). Each revision included improvements in the measure's empirical foundations and broadened the range of occupations to incorporate work previously regarded as suitable for only one sex or the other (Hansen, 1986).

The most recent revision (Harmon et al., 1994) has been renamed the Strong Interest Inventory (SII). It represents a most vigorous effort to further enhance the Strong's psychometric properties, minimize sex-bias distortion, and employ norm samples reflecting the vocational interests of the current work force.

Throughout the Strong's history, researchers have been particularly concerned with its validity. Such concern is entirely appropriate, given that the information provided by the measure is typically incorporated in making decisions about the type of work one might wish to do. The next section will review validity studies conducted on the various revisions of the Strong.

Validity Studies

The hallmark of the Strong is that it has been characterized by attention to criterion-related validity. Studies have been done on both concurrent and predictive validity.

The earliest validity studies on the SVIB were reported by E. K. Strong (1943). He found greater-than-chance scores for a sample of 140 men on scales representing their occupational choice both as college seniors in 1927-28 and on retest 10 years later. Also reported were data from a group of college freshmen tested first in 1930 and again in 1939 with similar results, though interest prediction was slightly less accurate for the freshman than the seniors. This difference was attributed to the younger students having less stable occupational choices and interests that were not yet well established. Overall, Strong drew the following conclusions: men who continued in a given occupation produced scores for that occupation higher than their other scores, higher than the scores of men in other occupations, and higher than the scores of men who changed from the first occupation to another. He also concluded men who changed occupations produced higher scores on their second occupation prior to the change than on any other scale. While the data Strong reported in his 1943 book can not be readily compared to the results of later studies, it is remarkable he was able to take

interest measurement as far as he did given he worked with far less information than that available to later investigators.

Strong reported further evidence for the predictive validity of the measure in a later follow-up study (Strong, 1955). The participants were more than 600 men who were tested while they were students at Stanford University and whose occupation at the time of follow-up could be matched with an appropriate occupational scale. The study compared the men's college scores to their occupations 18 years after testing. Strong summarized his findings in the following statement:

> In terms of expectancy ratios there are 3.6 chances to 1 that a man with an A rating will enter that specific occupation and 5.0 chances to 1 that a man with a C rating will not enter the occupation. (Strong, 1955, p. 54)

McArthur (1954) conducted a follow-up study of 60 men who completed the SVIB during their sophomore year at Harvard. Fourteen years later, their current jobs were compared to their scores on the Occupational Scales to determine the predictive validity of the Scales. McArthur's method of assessing hit rates involved identifying the Occupational Scale which most closely resembled each participant's current job and making a judgment as to whether that scale was a direct or an indirect measure of interest in the current

occupation. Predictive validity was then assessed in terms of good hits, poor hits, and clean misses. Good hits occurred when a participant's current job matched one of his four highest scale scores, poor hits when current job matched a scale scored lower than several other scales (but still above a minimum), and clean misses when current job met neither of these criteria. Predictive validity of the Occupational Scales for this sample yielded 45% good hits, 20% poor hits, and 35% clean misses. McArthur concluded there was evidence to support the measure's capacity to predict future behavior "at least 1 time in 2" (p. 352).

Dolliver, Irvin, and Bigley (1972) examined predictive and concurrent validity of the SVIB-M Occupational Scales for a sample of men who had completed the 1957 SVIB 12 years earlier. They used two procedures for classifying hits: McArthur's (1954) method and their own more conservative approach which omitted those participants for whose current jobs there were no applicable Occupational Scales. They concluded predictive validity of the SVIB for their sample was similar to the results of earlier studies and Occupational Scale scores were excellent predictors over time "for somewhat less than 50%" and poor predictors over time for about one-third of a general college sample. Concurrent validity, based on estimates of helpfulness of test interpretation, was lower than the researchers had anticipated, with participants

equally divided into three categories: helpful (34%), some use (32%), and misleading (34%).

Concurrent validity of the General Occupational Themes (GOT), Basic Interest Scales (BIS), and Occupational scales for a group of men who completed the men's SVIB was examined by Dolliver (1975). The investigator defined a hit as a scale score at or above 55 on the GOTs, 58 on the BISs, and 45 on the Occupational scale most relevant to current occupation. After adjusting for chance, hit rates were 39% for the GOTs, 41% for the BISs, and 30% for the Occupational scales.

Using the same criteria as Dolliver (1979), Cairo (1979) investigated the concurrent validity of the GOTs and BISs of the men's SVIB with a group of 36-year-old men participating in a longitudinal study of career development. After adjusting for chance, Cairo found hit rates of 47% for the GOTs and 44% for the BISs. The author suggested the higher validity rates found in this study might have resulted from the use of data on occupational groups (Campbell & Holland, 1972) to assign participants to GOTs and from participants providing not only their occupational titles, but descriptions of their jobs, allowing their current occupations to be more precisely identified.

Bartling and Hood (1981), on the other hand, found lower hit rates for the men's and women's forms of the SVIB than did other researchers. Participants in this study were surveyed

for current occupation and the predictive validity of their SVIB profiles, completed 11 years earlier while they were college students, was examined. The results indicated 32.7% good hits for women and 32.5% for men when only the highest Occupational scale score was used as a predictor. When the average of a group of SVIB scores (based on Stephenson's [1961] criteria) was used as a predictor, there were 13.3% good hits for women and 31.2% for men. The authors suggested the lower predictive validity found in their study may have resulted from the design. Their method involved predicting future occupation from the SVIB, then comparing the prediction to current occupation, a task similar to that facing vocational counselors.

Worthington and Dolliver (1977) used McArthur's (1954) method to examine the validity of both the SVIB (Campbell, 1966) and its revision, the Strong-Campbell Interest Inventory (SCII; Campbell, 1974). Their sample included the same men who participated in the earlier study by Dolliver et al. (1972). Predictive validity for the SVIB was 42% (good hits), consistent with the results of other studies. After correction to account for base rates, concurrent validity was better on the SCII (39% good hits) than on the SVIB (29% good hits).

The McArthur (1954) method was also used by Spokane (1979a) to examine validity of the SCII (Campbell, 1974) for

men and women. Predictive validity (direct hits) was 42.5% for women and 59.3% for men. Concurrent validity (direct hits) of the measure was 58% for women and 64% for men. While validity estimates for the men were consistent with the author's expectations based on earlier studies, Spokane questioned the results for the women. He suggested validity estimates for the women might have resulted from the use of a single rater (the author) to match an Occupational Scale with each participant's stated occupational preference, rather than from actual differences in validity.

In 1975, Whitton used choice of major and occupation as criteria to examine concurrent validity of the SCII (Campbell, 1974) for a group of 180 male and female college students. The method was similar to McArthur (1954) and Dolliver et al. (1972), but without the use of an "omit" category. The results indicated concurrent validity on the General Occupational Themes and Basic Interest Scales was highest for all participants when the profiles were scored without using sex norms. Even more impressive was the significant increase in hit rate percentage when profiles were scored on all Occupational Scales, not just those of the same sex. Hit rates for women increased from 44% to 59%, for men from 42% to 56%, and for the total sample from 43% to 58%. Whitton's data supported reporting scores for <u>all</u> Occupational Scales to test respondents.

Spokane (1979b) investigated the concurrent and predictive validity of the GOTs using the SCII (Campbell, 1977) with male and female college students who completed the measure immediately before entering the first year of college and again during the senior year. Predictive validity was 34.4% for women and 39.7% for men where a hit was defined as an identical match between a senior's occupational preference and the highest GOT code from his or her SCII taken 4 years earlier. Concurrent validity was 34.4% for women and 43.6% for men where a hit was defined as an identical match between a senior's occupational preference and his or her highest GOT code on the SCII taken as a senior. The author suggested the differences in predictive validity for men and women were modest and could have resulted from the use of raw *t* scores. It is also noteworthy that there were about twice as many men (n=304) as women (n=157) in the sample. Spokane concluded the results offered partial support for the validity of the GOTs for both men and women.

Borgen (1972) employed univariate and discriminant function methods to compare the predictive capacities of the SVIB (Campbell, 1966) Occupational and Basic Interest Scales. The use of scales as predictor sets introduced a new approach to validity studies. The study involved a group of 780 male National Merit Scholars, separated into validation (n=511) and cross-validation (n=269) samples. In predicting career choice

for the cross-validation sample, the Occupational Scales had a direct hit rate of 23% and the Basic Interest Scales a direct hit rate of 24.5%, both of which were considerably greater than chance (14.5%). When career groups were dichotomized into science and non-science fields, the hit rate was approximately 50% greater than chance: 69.1% for the Occupational Scales and 72.5% for the Basic Interest Scales. The author concluded only minor differences in predictive capacities existed between the two sets of scales. He suggested the Basic Interest Scales could be especially useful in guiding early career exploration and in identifying occupational and curricular areas for additional consideration, while the Occupational Scales remained the best predictors of membership in specific occupations.

In a subsequent study, Borgen and Helms (1975) also employed the discriminant function technique to investigate the predictive capacity of the Occupational Scales when used with female National Merit Scholars and compare hit rates for males and females. The cross-validation sample included the male Scholars from the 1972 study (Borgen, 1972) and 452 female Scholars, all of whom completed the men's form of the SVIB (Campbell, 1966) at the same time. In predicting career choice, the Occupational Scales had a direct hit rate of 23% for men and 21.2% for women. The men's hit rate was greater than chance (14.5%), while the women's hit rate was somewhat

less than chance owing largely to their appreciably greater base rate of 23%. When career choices were dichotomized into science and non-science groups, however, the hit rate for the Occupational Scales exceeded chance for both men and women. The hit rate was 69.1% for men compared to a base rate of 51.3% and for women 74.1% compared to a base rate of 63.3%. Borgen and Helms concluded the interests of the participants were more alike than different and the recently published cross-sex Occupational Scales of the SCII (Campbell, 1974) could be particularly useful in counseling, especially when considering broad vocational dimensions such as science and non-science career groups.

Hansen and Swanson (1983) examined concurrent and predictive validity of the Occupational scales for the 1981 revision of the SCII (Campbell & Hansen, 1981) using college major as the criterion. Participants completed the SCII during freshman orientation and again during the senior year. Using McArthur's (1954) method, the investigators found concurrent validity of 64% for the women and 60% for the men where a direct match existed between freshman college major and SCII profile taken at that time. Concurrent validity of 73% for women and 76% for men was found for the senior major and the senior year SCII. Predictive validity was tested by examining the correspondence between the freshman SCII and the senior year major. Hit rates of 57% for women and 53% for men

were found for profiles with a direct match between major and Occupational scale. For indirect matches, hit rates were 69% for women and 70% for men. The authors concluded the 1981 SCII could be used with confidence to predict college major, was slightly more effective with women than men, and had concurrent and predictive validity comparable to that of earlier revisions.

Hansen and Tan (1992) investigated the concurrent validity of the Occupational Scales on the 1985 revision of the SCII (Hansen & Campbell, 1985). Again using college major as the criterion, they followed McArthur's (1954) method of classifying the match between major and score on the relevant Occupational scale. There was no significant difference in hit rates for women and men. The Excellent and Moderate hit rate for women was 79.4%, for men 83.0%, and for the combined sample 80.8%. Results were comparable to those found in a study of the 1981 SCII where college major was also used as the criterion (Hansen & Swanson, 1983).

The Strong Interest Inventory Applications and Technical Guide (Harmon et al., 1994) offers evidence of validity for the 1994 revision. The General Occupational Themes (GOT) have been compared to other measures using Holland's (1973) six interest types with a large degree of overlap, indicating the instruments measure similar interest domains. Furthermore, graphic displays in the manual show means for different

occupations and college majors group themselves on the GOTs in ways that are theoretically consistent with the typology.

The Basic Interest Scales (BIS) of the SII demonstrate substantial concurrent validity in discriminating among occupational groups. Extensive graphic representations in the manual show occupational group members score highest on the scales most closely related to their occupations. Individuals tend to score at or below average levels on scales representing unrelated occupations. The authors (Harmon et al., 1994) note predictive validity of the BIS is less than concurrent validity, given the uncertainty associated with making predictions. They observe, however, that research on earlier Strongs has supported their predictive validity. Because the BIS on this latest version are substantially similar to those on older revisions, earlier findings can be generalized to the SII.

Evidence for concurrent validity of the Occupational Scales is provided in percentage of overlap between the scores of an occupational group and the scores of the General Reference Sample. While the manual shows considerable variation in percentage of overlap among the Occupational Scales, thus variation in concurrent validity, differences are consistent with the degree to which an occupation can be precisely defined and the extent to which it is distinct from other occupations. For example, the Physicist scale has much

higher concurrent validity (less overlap) than the Small Business Owner scale. Additional evidence for concurrent validity is derived from the fact that the mean score for an occupational sample on other occupation scales separates the groups well, except in cases where similarity exists between the occupations.

Donnay (1995), and Donnay and Borgen (in press) recently conducted multivariate analyses of the 50 occupations in the General Reference Sample of the 1994 SII (Harmon et al., 1994). Using combined-sex samples, they found direct hit rates of 8.56% for the newly created Personal Style Scales, 10.41% for the General Occupational Themes, and 21.76% for the Basic Interest Scales. These results are 4, 5, and 10 times better than chance, respectively.

Measurement of Women's Vocational Interests

The first attempt to distinguish among women's vocational interests was published by Hogg in 1928, the year after the Strong first appeared. The results indicated women's vocational interests could be differentiated, though not as clearly as men's. The author concluded there was probably little difference among the interests of women in various occupations and stated,

> ...their interests are similar in that they all want to do something;...they are in the particular occupations which offered the least resistance for them to satisfy

> the desire to do something, to be modern women....women work not for love of the work itself, but to be busy. (Hogg, 1928, p. 337)

Manson (1931) also attempted to distinguish among the interests of women in various occupations with results similar to those of Hogg (1928). The outcome led her to suggest women's vocational interests might not be as strong as men's, possibly because they expected to marry and leave their jobs or because their employers offered them less prospects for advancement.

The women's form of the SVIB was first published in 1933 (Strong, 1933). Following its use over the next several years, Strong drew some conclusions about measurement of women's vocational interests in his classic work, Vocational Interests of Men and Women (1943). He stated there was no difference between men and women in the SVIB's capacity to differentiate among some of the occupational groups included in the measure as it then existed. However, Strong believed the addition of more occupations would reveal men could be differentiated for a larger number of occupations than women could. He viewed women as entering occupations from convenience, rather than intent, to pass the time until they married. The result, Strong posited, was that many women were engaged in occupations they would not otherwise have chosen. Women's occupational groups were, therefore, too heterogeneous

to be used in creating criterion groups that differentiated effectively among occupations. He went on to assert the sexes were more alike than different and men's and women's scales for some occupations (e.g., Artist) could be used interchangeably. Strong concluded, however, it was best to maintain separate men's and women's forms and to score each sex on its own scales. He continued to espouse this same view some years later when he published a follow-up study of men's interests (Strong, 1955), stating "...the writer cannot recommend the use of the men's blank for the majority of women" (p.172).

Separate SVIB forms for men and women were maintained although career counselors found it increasingly difficult to derive sufficient information for many of their female clients from the women's form. Not surprisingly, counselors often heeded the advice of Darley and Hagenah (1955), who advocated the use of both the men's and women's forms with women who possessed high career motivation, maturity, and ability. Because the men's form included more occupational families and specific occupations, examining interest patterns across the two forms led to "...better vocational counseling and more imaginative consideration of alternatives on the part of the student" (p. 71).

Harmon (1973a), writing about the 1969 revision of the women's SVIB (Campbell, 1969), stated that difficulties in

measuring women's interests had been resolved through careful attention to selecting both items and members of occupational criterion groups, though she noted an absence of scales for nontraditional occupations (e.g., truck driver). Concurrent validity was improved and Harmon expressed hope that this revision might finally establish adequate predictive validity for women's interest measurement, as well. She urged counselors to encourage their women clients to make career decisions on the basis of self-knowledge and "not on the basis of romanticized stereotypes" (p. 85).

In this same time period, amidst the social upheaval of a nation questioning its traditional beliefs and mores, a number of writers (including Harmon) began to examine issues of sex-bias in interest measurement. Johansson and Harmon (1972), among others, raised critical questions for the field. They suggested separate forms of the SVIB could promote sex-based discrimination by implying occupations scaled on only one form or the other were suitable only for that sex or that occupations scaled on both forms required different interests and involved different tasks for one sex or the other. They calculated response percentage differences on the SVIB between women and men in 14 occupations for the 229 items common to both forms. Of the 42% of items that differentiated between men and women in the same occupation, most were not included on the pertinent occupational scale as they did not help

distinguish the occupation from the general population. Their results suggested the occupational scales probably included more items relevant to sex role stereotypes than items representing valid differences between men and women in the same occupation. They called for a combined-sex form of the Strong with both sexes equally represented in the occupational criterion groups.

Cole (1973) expressed concern that traditional women's interest measures limited the number of careers women considered. Examining the spatial configuration of women's occupational criterion groups on the SVIB according to Holland's typology, she found the interest structure for women to be quite similar to that for men. Given that no women's scales existed for many male-dominated occupations, Cole's results shed new light on interpreting women's interests.

Speaking before the American Personnel and Guidance Association (APGA) convention in March 1972 (see Harmon, 1973b), Harmon called for changes in interest measurement to eliminate sex bias. She identified several sources of bias including sex-specific item wording, separate item pools for men and women, failure to include both sexes in criterion groups, different occupational scales for men and women, norms based on scales containing sexually stereotypic items, and scores compared only to same-sex norms. A proposed resolution, authored by Schlossberg and Goodman (see American

Measurement and Evaluation in Guidance [AMEG], 1973), was presented to the APGA Senate, then referred to AMEG for study. The resolution specifically called for changes in the SVIB to reduce or eliminate sex bias. The next revision, renamed the Strong-Campbell Interest Inventory (SCII; Campbell, 1974), featured the instrument's first merged sex form as well as other changes responsive to AMEG's concerns.

The zeitgeist and the revolutionary changes in an instrument that served as a standard for many in the field of interest measurement combined to stimulate both research and reflection on sex bias in testing.

Borgen and Helms (1975) employed discriminant function analysis to examine use of the men's SVIB with a group of men and women who were National Merit Scholars in 1966. They found the men's form was generalizable to women and the men and women showed similar career interest structures. Their results supported the utility of cross-sex Occupational scales such as those incorporated in the recently-published SCII (Campbell, 1974).

The National Institute of Education funded publication of a report (Diamond, 1975) documenting sex bias and sex restrictiveness in interest measurement. Test developers and publishers responded by revising their measures, gathering improved normative data, combining men's and women's forms, discussing issues related to sex role socialization in test

interpretation manuals, and reducing the sex restrictiveness of reported scores (Betz, 1987). Sadly, however, no measure can ensure individuals will have a range of experiences which broaden their vocational interests beyond those considered stereotypic of their sex.

Since the landmark publication of its merged sex form in 1974, the Strong has undergone three revisions: 1981 (Campbell & Hansen), 1985 (Hansen & Campbell), and most recently, 1994 (Harmon et al.). Each has endeavored to improve on the measure's sex fairness. The outcome of these efforts for the 1981 and 1985 revisions was recently recognized by Lewin and Wild (1991) who termed the instrument "...an example of the success of the feminist critique in assessment" (p. 588).

Without intending to detract from the significant improvements already incorporated into the Strong, it is important to acknowledge the possibility that more subtle manifestations of sex restrictiveness remain embedded in the fabric of the measure. Betz (1993) provided a thought-provoking example. The General Occupational Themes, based on Holland's typology, are composed of items that reflect sex stereotyped experiences. Earlier studies (Gottfredson, Holland, & Gottfredson, 1975; Prediger & Hanson, 1976; cited in Betz) show women obtain higher mean scores on the Social, Artistic, and Conventional themes while men obtain higher means on the Realistic, Investigative, and Enterprising

themes. High scores on the Social and Conventional themes can lead to suggestions of traditionally female-dominated occupations such as clerical work and social welfare for women, while minimizing the exploration of traditionally male-dominated occupations represented by the Realistic and Investigative themes. The converse of this pattern affects men.

The most recent revision of the Strong is the 1994 Strong Interest Inventory (Hansen et al., 1994). Recent work by Donnay (1995), and Donnay and Borgen (in press) used the multivariate technique of discriminant function analysis to investigate the concurrent validity of the newly-incorporated Personal Style Scales, the General Occupational Themes, and the Basic Interest Scales. Using the General Reference Sample (the norm group for the 1994 Strong) of 18,951 employed women and men, representing 50 occupations, they examined the measure's capacity for predicting occupational group membership. While the results indicated all of the scales were effective, the Basic Interest Scales formed the most powerful predictor set, with noteworthy contributions to identifying occupational group membership made by the Personal Style Scales and General Occupational Themes, as well.

The Purpose of this Study

The purpose of this study was to examine the concurrent validities of the Personal Style Scales, the General

Occupational Themes, and the Basic Interest Scales when only gender-balanced occupational criterion groups were included in the sample. The multivariate technique of discriminant function analysis was used in the investigation. The results were expected to show an increase in validity estimates over those found by Donnay (1995), and Donnay and Borgen (in press). It also investigated the concurrent validity of the three scale groups when the samples were analyzed separately by gender, again expecting an increase in validity over that shown in the first analysis. It was further anticipated concurrent validities for both sexes on the three scale groups would increase as the predictor sets contained a greater number of variables and more specific variables. Finally, it was expected concurrent validities of the predictor sets would be greater for men than for women.

METHOD

Participants

In the course of creating the 1994 Strong Interest Inventory (Harmon et al., 1994), more than 55,000 employed adults representing 50 occupations completed a research version of the measure in 1992 and 1993. Respondents were then screened on the basis of several criteria; job satisfaction, experience, typicality of job description, and age. Individuals retained in the sample were those who reported feeling "very satisfied" or "somewhat satisfied" with their work, who had at least 3 years of experience on the job, and whose job duties were typical of their occupation. The minimum requirement of 3 years on the job ensured that most participants were at least 25 years old. Respondents over the age of 60 were included if they met the previous three criteria. The screening process yielded a pool of approximately 40,000 occupational group members. A subset of 18,951 individuals was randomly selected from the pool so that most occupational criterion groups included 200 women and 200 men. For the eight occupational groups with less than 200 respondents, all group members were included. These 18,951 respondents comprise the norm group referred to as the General Reference Sample (GRS) in the Strong Interest Inventory Applications and Technical Guide (Harmon et al., 1994).

The average age for women in the GRS was 40.5 years and for men 44.6 years. Women had been in their occupations an average of 13.8 years and men an average of 18.2 years. The percentage of respondents who described themselves as very satisfied with their work was 58.7 for women and 61.8 for men, while the remainder of the sample reported being somewhat satisfied. Women and men were equally represented in the majority of occupational groups, resulting in subsamples of 9,467 women and 9,484 men. Table 1 lists the occupational groups and the number of women and men in each.

For this study, seven occupational groups were eliminated from the analyses due to their unequal gender representation: bookkeeper, child care provider, farmer, gardener/groundskeeper, paralegal, plumber, and police officer. The remaining sample of 17,165 was used in the univariate analysis and multivariate discriminant analyses examining concurrent validity for the combined-sex sample. To compare concurrent validity of the predictive measures by sex, half of the women and men within each occupational group were randomly selected as a validation group while the remaining half served as a cross-validation group.

Predictive Measures

The 1994 Strong Interest Inventory (Harmon et al., 1994) is the latest revision of the Strong. This 317-item questionnaire surveys interest in a broad range of

Table 1 Occupational groups in General Reference Sample: Sample sizes by sex

Occupation	Women n=9,467	Men n=9,484
Accountant	200	200
Actuary	200	200
Advertising Executive	200	200
Architect	200	200
Audiologist	200	200
Auto Mechanic	165	200
Banker	200	200
Biologist	200	200
Bookkeeper[a]	200	116
Business Education Teacher	200	200
Chemist	200	200
Child Care Provider[a]	200	0
Community Service Organization Director	200	200
Computer Programmer/Systems Analyst	200	200
Corporate Trainer	200	200
Credit Manager	200	200
Dentist	200	200
Elementary School Teacher	200	200
Engineer	200	200
Farmer[a]	92	152
Flight Attendant	200	200
Forester	200	200
Gardener/Groundskeeper[a]	94	200
Housekeeping/Maintenance Supervisor	200	200
Human Resources Director	200	200
Lawyer	200	200
Librarian	200	200
Life Insurance Agent	200	200
Marketing Executive	200	200
Medical Records Technician	200	200
Nurse, Registered	200	200
Nursing Home Administrator	200	200
Occupational Therapist	200	200
Paralegal[a]	200	120
Parks and Recreation Coordinator	200	200
Pharmacist	200	200
Physicist	200	200
Physical Therapist	200	200
Plumber[a]	0	96
Police Officer[a]	116	200
Public Relations Director	200	200
Radiologic Technologist	200	200
School Administrator	200	200
Small Business Owner	200	200

Table 1 (continued)

Occupation	Women n=9,467	Men n=9,484
Social Worker	200	200
Special Education Teacher	200	200
Speech Pathologist	200	200
Technical Writer	200	200
Translator	200	200
Veterinarian	200	200

[a]Note. Occupation not included in this study.

occupations, occupational and leisure activities, hobbies, school subjects, and types of people. It is an empirically based and highly respected instrument, widely used in both research and practice. While introducing several innovative features, the 1994 revision maintained the best traditions of its predecessors, the Strong Vocational Interest Blank (Strong, 1927) and the Strong-Campbell Interest Inventory (Campbell & Hansen, 1981). The measure is designed to help the respondent identify and organize interest patterns which are an essential part of making educational and occupational decisions. It also helps identify interests in different types of people and environments, as well as interests in leisure pursuits.

Elements of the 1994 Strong Interest Inventory pertinent to this study are the General Occupational Themes, the Basic Interest Scales, and the newly created Personal Style Scales. All three sets of scales have standard scores derived from the combined-sex GRS, with a mean of 50 and standard deviation of 10.

Personal Style Scales. The Personal Style Scales appear on the Strong for the first time in the 1994 revision. They measure favored styles of living and working by identifying the ways in which individuals prefer to learn, work, play, and conduct their lives. These are bipolar scales that have a characteristic style associated with each end of the scale.

The four Personal Style Scales are Work Style, Learning Environment, Leadership Style, and Risk Taking/Adventure.

The Work Style scale distinguishes between those who prefer to work with people and those who prefer to work with ideas, data, or things. High scorers prefer people-oriented occupations, while low scorers prefer more solitary types of work. Women tend to score higher than men on this 51-item scale (mean of 53.1 for women, 46.9 for men in the GRS). Six of the Work Style scale items are new additions to the Strong. They identify preferences among all combinations of working with people, ideas, data, and things. From the GRS, individuals preferring one of those options to all the others were separated into two groups: those who preferred working with people and those who preferred working with things, data, or ideas. The scale was constructed by identifying items for which there was a difference in response rate of at least 16% between the two groups and combining them with the six items already described, for a total of 51 items. Internal consistency for the scale is high, with a Cronbach's alpha of .91. Test-retest reliability with four different samples was remarkably stable with correlations ranging from .86 to .92 (Harmon et al., 1994). The Work Style scale does, however, show a high degree of correlation with the Leadership Style scale (.61 for men, .52 for women).

The Learning Environment scale distinguishes between people who prefer academic learning environments and those who prefer more applied, practice-oriented situations (Harmon et al., 1994). High scorers are typical of those whose occupations require extensive academic preparation. The scale is composed of 49 items which differentiated between members of the GRS with master's and Ph.D. degrees, and those whose highest degree was earned at a technical or trade school. Women and men in the GRS obtained identical mean scores (50.0) on this scale. Internal consistency is high, with a Cronbach's alpha of .86. Test-retest reliability with four different samples ranged from .83 to .91, supporting stability of the scores over time (Harmon et al., 1994). The Learning Environment scale is modestly correlated with the Leadership Style scale (.50 for women, .49 for men), but not with the remaining two scales.

The Leadership Style scale is composed of 23 items derived from factor analyses of items on the Strong. It reflects preferred leadership role, differentiating between high scorers who are comfortable being in charge and motivating others, and low scorers who prefer to lead by example or complete tasks themselves. The means for women and men in the GRS are virtually identical (50.1 for women, 50.0 for men). Internal consistency of this scale matches that of the Learning Environment scale (Cronbach's alpha of .86). The

scale demonstrated stability over time with four different samples. Test-retest correlations ranged from .81 to .88 (Harmon et al., 1994).

The Risk Taking/Adventure scale is similar to the former Adventure Basic Interest Scale first constructed in 1968 (Campbell, Borgen, Eastes, Johansson, & Peterson, 1968; Campbell, 1971). Because it seems to capture a style of working and playing, it was moved to the Personal Style Scales (Harmon et al., 1994). Risk Taking/Adventure distinguishes between high scorers who prefer risky, adventurous activities and low scorers who do not. Men typically score higher on this scale than women (mean of 53.1 for men, 46.9 for women in the GRS). Scores tend to decrease with age, suggesting the scale reflects current behavior better than it predicts future behavior (Harmon et al., 1994). Although this is a short scale (9 items), Cronbach's alpha is an acceptable .78. It is quite stable across time, with test-retest correlations ranging from .85 to .89 over four samples (Harmon et al., 1994). The scale is modestly correlated with Leadership Style, but is essentially unrelated to the other two Personal Style scales.

General Occupational Themes. The General Occupational Themes apply Holland's typology to the Strong (Campbell & Holland, 1972). The six types are Realistic, Investigative, Artistic, Social, Enterprising, and Conventional. Scores on

these homogeneous scales provide a broad picture of the respondent's preferred vocational interests and styles. Internal consistency is remarkably high, with Cronbach's alphas ranging from .90 on the Social scale to .94 on the Artistic scale (Harmon et al., 1994). Test-retest reliabilities with four different samples ranged from .74 to .92, indicating stability over time (Harmon et al., 1994). The lower correlations were produced by college student samples who, by definition, were likely to still be exploring their interests, while the higher correlations were produced by a sample of employed adults. Concurrent validity of the General Occupational Themes has been assessed by comparison with similar interest measures (e.g., the Vocational Preference Inventory) and the scales separate occupations in a theoretically consistent manner (Hansen, 1986).

Basic Interest Scales. The 25 Basic Interest Scales provide more specific information about interests than the General Occupational Themes, with each scale covering a particular domain of work and lifestyle. Internal consistency is robust, with Cronbach's alphas ranging from .74 for Agriculture (6 items) to .94 for Mechanical Activities (21 items) (Harmon et al., 1994). Stability of scores over time is also high, with tes-retest correlations ranging from .70 to .94 (Harmon et al., 1994). The Basic Interest Scales are generally better occupational predictors than the General

Occupational Themes due to their greater specificity (Hansen, 1986).

Criterion Groups

Occupational group membership. The 17,165 employed adults from the GRS used in this study represent 43 different occupations. Respondents' occupations were coded from their job titles, a method previously demonstrated to be an appropriate criterion measure of group membership (Humphreys, Lubinski, & Yao, 1993). See Table 1 for a list of the occupational groups and the number of women and men in each group.

Design and Analyses

Each of the 4 Personal Style Scales, the 6 General Occupational Themes, and the 25 Basic Interest Scales was examined for its ability to discriminate among occupational groups. The contribution of each of the 35 variables to occupational group separation was examined by performing 35 univariate ANOVAs to calculate the F ratio for each scale (Borgen & Seling, 1978). Wilks' lambda was used as a descriptive index of the discriminant capacity of each scale.

Multivariate discriminant function analysis and hierarchical discriminant function analysis was used to examine the validity of the three predictor sets: the 4 Personal Style Scales, the 6 General Occupational Themes, and the 25 Basic Interest Scales. Discriminant function analysis

is an appropriate method for explaining and predicting multivariate group differences (Betz, 1987; Borgen & Seling, 1978). Primary indicators of multivariate prediction were overall Wilks' lambda and cross-validated hit rates.

In order to cross-validate the results, the sample was randomly divided into validation and cross-validation groups, each containing equal numbers of women and men. Three discriminant function analyses were used to compare the ability of each predictor set to accurately identify occupational group membership. Hierarchical discriminant function analysis, specifying the order in which variables are considered, was used to identify the additional variance accounted for by the Personal Style Scales after controlling for the General Occupational Themes and the Basic Interest Scales. Analyses were conducted to examine the sample as a whole, then repeated for the single-sex samples.

RESULTS

Both univariate and multivariate methods were employed in this study to examine the concurrent validity of three sets of scales on the 1994 Strong Interest Inventory. The analyses were performed through SPSS for Windows, Professional Statistics, Release 6.0 (Norusis, 1993).

Univariate Analyses

The full sample (N=17,165) was randomly divided into two samples, A and B. Univariate ANOVAs were conducted for Samples A and B on each of the 35 variables (scales) to examine the contribution of each variable to occupational group separation. The *F* ratio and Wilks' lambda for each scale were calculated and are shown in Table 2.

Each variable was considered individually here, with lambda being the ratio of within-groups sum of squares to total sum of squares (Betz, 1987). All 35 variables were highly significant ($p < .00005$), indicating each variable contributed to occupational group separation. Wilks' lambdas ranged from .697 for the Work Style scale to .974 for the Culinary Arts scale. Recalling that Wilks' lambda has a value of 1 when all groups are equal and a value nearer 0 when most of the variability results from between-groups differences (Betz, 1987; Borgen, 1972), it is apparent that some variables contributed more to group separation than did others. The Work Style scale, with a lambda of .701 for Sample A and .697

Table 2. Univariate analysis of group separation for combined-sex sample: Wilks' lambda and F-ratio, N = 17,165

Variable	Sample A		Sample B	
	Wilks' Lambda	F*	Wilks' Lambda	F*
Personal Style Scales				
Work Style	.701	86.82	.697	88.38
Learning Environment	.761	63.91	.762	63.60
Leadership Style	.845	37.34	.846	36.89
Risk Taking/Adventure	.955	9.51	.948	11.17
General Occupational Themes				
Realistic	.875	29.08	.886	26.22
Investigative	.772	60.16	.765	62.57
Artistic	.883	26.88	.891	24.88
Social	.889	25.43	.883	27.06
Enterprising	.845	37.42	.840	38.69
Conventional	.852	35.32	.851	35.46
Basic Interest Scales				
Agriculture	.892	24.54	.889	25.39
Nature	.897	23.23	.893	24.29
Military Activities	.970	6.27	.963	7.91
Athletics	.916	18.67	.902	22.21
Mechanical Activities	.856	34.17	.874	29.22
Science	.744	70.03	.745	69.55
Mathematics	.802	50.23	.794	52.62
Medical Science	.819	44.95	.804	49.60
Music/Dramatics	.910	20.00	.918	18.08
Art	.898	23.07	.901	22.35
Applied Arts	.905	21.24	.910	20.07
Writing	.858	33.75	.867	31.25
Culinary Arts	.974	5.49	.972	5.90
Teaching	.870	30.33	.862	32.68
Social Service	.864	32.11	.864	32.02
Medical Service	.790	53.99	.776	58.60
Religious Activities	.968	6.67	.965	7.28
Public Speaking	.882	27.22	.883	26.95
Law/Politics	.912	19.74	.914	19.04
Merchandising	.830	41.74	.825	43.25
Sales	.796	52.23	.800	50.77
Organizational Management	.766	62.05	.759	64.88
Data Management	.821	44.34	.815	46.30
Computer Activities	.905	21.26	.914	19.15
Office Services	.837	39.54	.838	39.29

*$p < .00005$

for Sample B, contributed most to group separation among both the Personal Style scales and among all the scales examined. Within the General Occupational Themes, the Investigative scale made the greatest contribution to group separation for both Sample A (Wilks' lambda = .772) and Sample B (Wilks' lambda = .765). The Science scale contributed most to group separation among the Basic Interest Scales for both Sample A (Wilks' lambda = .744) and Sample B (Wilks' lambda = .745).

Following the above analysis of the combined-sex samples, univariate analyses were performed separately for women and men with each single-sex group randomly divided into two samples, A and B. The F ratio and Wilks' lambda for each variable for the women's group are shown in Table 3 and for the men's group in Table 4. The results for the single-sex samples were largely consistent with those for the combined-sex samples. All 35 variables were highly significant ($p < .00005$) for both women and men, indicating each variable contributed to occupational group separation.

The Work Style scale again made the greatest contribution to group separation for both women (Sample A Wilks' lambda = .675, Sample B Wilks' lambda = .655) and men (Sample A Wilks' lambda = .675, Sample B Wilks' lambda = .671). Among the General Occupational Themes, the Investigative scale contributed most to group separation for both women (Samples A and B Wilks' lambda = .723) and men (Sample A Wilks' lambda =

Table 3. Univariate analysis of group separation for women: Wilks' lambda and F-ratio, n = 8,565

Variable	Sample A Wilks' Lambda	Sample A F*	Sample B Wilks' Lambda	Sample B F*
Personal Style Scales				
Work Style	.659	52.13	.655	53.16
Learning Environment	.728	37.67	.738	35.75
Leadership Style	.841	19.15	.836	19.83
Risk Taking/Adventure	.934	7.19	.927	7.99
General Occupational Themes				
Realistic	.814	23.05	.836	19.74
Investigative	.723	38.73	.723	38.70
Artistic	.873	14.64	.892	12.24
Social	.891	12.34	.889	12.64
Enterprising	.832	20.37	.832	20.37
Conventional	.805	24.50	.833	20.26
Basic Interest Scales				
Agriculture	.872	14.80	.880	13.82
Nature	.873	14.74	.881	13.61
Military Activities	.955	4.76	.956	4.67
Athletics	.918	9.02	.913	9.61
Mechanical Activities	.797	25.79	.822	21.87
Science	.704	42.43	.707	41.81
Mathematics	.767	30.72	.760	31.92
Medical Science	.799	25.35	.789	26.97
Music/Dramatics	.908	10.23	.918	9.01
Art	.894	12.03	.902	10.98
Applied Arts	.890	12.50	.896	11.76
Writing	.861	16.34	.881	13.64
Culinary Arts	.969	3.22	.966	3.51
Teaching	.879	13.89	.876	14.32
Social Service	.870	15.04	.872	14.84
Medical Service	.779	28.58	.769	30.40
Religious Activities	.961	4.13	.961	4.09
Public Speaking	.870	15.07	.873	14.65
Law/Politics	.897	11.54	.909	10.14
Merchandising	.817	22.62	.815	22.86
Sales	.780	28.46	.789	27.03
Organizational Management	.753	33.09	.741	35.29
Data Management	.807	24.09	.799	25.43
Computer Activities	.869	15.23	.890	12.51
Office Services	.767	30.73	.809	23.89

*$p < .00005$

Table 4. Univariate analysis of group separation for men: Wilks' lambda and F-ratio, n = 8,600

Variable	Sample A Wilks' Lambda	Sample A F*	Sample B Wilks' Lambda	Sample B F*
Personal Style Scales				
Work Style	.675	48.84	.671	49.77
Learning Environment	.773	29.69	.766	30.94
Leadership Style	.834	20.15	.839	19.38
Risk Taking/Adventure	.946	5.80	.936	6.88
General Occupational Themes				
Realistic	.883	13.41	.879	13.91
Investigative	.801	25.22	.786	27.58
Artistic	.863	16.11	.847	18.30
Social	.871	14.95	.857	16.88
Enterprising	.848	18.20	.838	19.55
Conventional	.882	13.58	.856	17.04
Basic Interest Scales				
Agriculture	.881	13.75	.866	15.67
Nature	.899	11.41	.881	13.68
Military Activities	.962	4.03	.936	6.89
Athletics	.873	14.77	.843	18.91
Mechanical Activities	.864	16.00	.871	15.06
Science	.762	31.69	.762	31.58
Mathematics	.819	22.35	.808	24.06
Medical Science	.821	22.09	.799	25.51
Music/Dramatics	.887	12.96	.880	13.78
Art	.871	14.98	.854	17.30
Applied Arts	.906	10.52	.896	11.76
Writing	.831	20.59	.824	21.63
Culinary Arts	.956	4.63	.955	4.82
Teaching	.848	18.17	.834	20.17
Social Service	.830	20.76	.827	21.17
Medical Service	.785	27.74	.762	31.59
Religious Activities	.964	3.79	.958	4.42
Public Speaking	.877	14.24	.870	15.12
Law/Politics	.905	10.70	.896	11.75
Merchandising	.831	20.67	.821	22.05
Sales	.798	25.71	.795	26.12
Organizational Management	.765	31.07	.761	31.90
Data Management	.821	22.08	.814	23.21
Computer Activities	.916	9.34	.920	8.78
Office Services	.877	14.22	.845	18.62

*$p < .00005$

.801, Sample B Wilks' lambda = .786). Of the Basic Interest scales, the Science scale contributed most to group separation for the women (Sample A Wilks' lambda = .704, Sample B Wilks' lambda = .707). For the men, the Science scale contributed most to group separation for Sample A (Wilks' lambda = .762), while the Organizational Management scale (Wilks' lambda = .761) and the Science and Medical Service scales (Wilks' lambda = .762) contributed most to group separation for Sample B.

Overall, there were only minimal differences among the scales at the univariate level within each of the three scale types (Personal Style Scales, General Occupational Themes, Basic Interest Scales). It is important to note, however, that the Work Style scale consistently contributed most to group separation across all three univariate analyses, among both the Personal Style Scales and among all 35 of the scales considered.

Multivariate Analyses

The multivariate analyses were conducted using the randomly selected samples described above for each of the groups examined. Thus, the combined-sex group included 17,165 individuals randomly divided into Sample A (n = 8,583) and Sample B (n = 8,582). The women's group included 8,565 individuals, again divided into Sample A (n = 4,283) and Sample B (n = 4,282). The men's group included 8,600

individuals, also divided into Samples A and B, each containing 4,300 persons. Separate discriminant analyses were performed for the combined-sex, women's, and men's groups.

Because the results of the discriminant analyses would be used for multivariate prediction of occupational group membership, the double cross-validation method (Betz, 1987) was used. In each case, Sample A was first used as the validation group, with the results cross-validated on Sample B, then Sample B was used as the validation group and the results cross-validated on Sample A. Within each group, the predictive capacity of each of the three predictor sets (Personal Style Scales, General Occupational Themes, Basic Interest Scales) was examined. Hierarchical discriminant function analysis, specifying the order in which variables are considered, was then used to identify the additional variance accounted for by the Personal Style Scales after controlling for the General Occupational Themes and the Basic Interest Scales. The hierarchical analysis was performed on the combined-sex group and on both of the single-sex groups.

Traditional indices of statistical significance were not employed because the sheer size of the samples used here would lead to findings of significance. Instead, the author set arbitrary standards of practical significance to determine whether predictor sets were more powerful for one group than another. In order to constitute a meaningful difference in

predictive power, the author decided the interpretive standard would be at least a 4% difference in the amount of between-groups variance accounted for or at least a 2% difference in direct hit rates between two groups.

The predictive capacity of the three predictor sets for the three groups (combined-sex, women, and men) is shown in Table 5. The results were quite similar across all three groups for the validation and cross-validation pairs on each predictor set.

Wilks' lambda was used here as a measure of effect size, reflecting concurrent validity of the predictor sets. Lambda has a value of 1 when all groups are equal and a value nearer 0 when most of the variability stems from between-groups differences (Betz, 1987; Borgen, 1972). Since one minus lambda equals the proportion of variance explained by group membership (Betz, 1987), smaller values of lambda occur where predictor sets contribute more to occupational group separation. For example, when Sample A of the combined-sex group was used as the validation sample, Wilks' lambda equaled .456 for the Personal Style Scales. Therefore, one minus lambda equals .544, indicating the Personal Style Scales accounted for 54.4% of occupational group separation in the sample.

Cohen's (1988) standard for interpreting effect size in the univariate case is also useful for appreciating lambda, as

Table 5. Discriminant function analyses: Multivariate prediction of membership in 43 occupations from three sets of Strong scales

Combined-sex sample

	Validation (Sample A)		Cross-Validation (Sample B)	Validation (Sample B)		Cross-Validation (Sample A)
	Wilks' Lambda	Direct Hits	Direct Hits	Wilks' Lambda	Direct Hits	Direct Hits
PSS	.456	9.6%	9.6%	.455	9.4%	9.3%
GOT	.357	11.5%	11.5%	.350	12.0%	11.3%
BIS	.086	25.6%	23.8%	.085	25.9%	23.2%

Women

	Validation (Sample A)		Cross-Validation (Sample B)	Validation (Sample B)		Cross-Validation (Sample A)
	Wilks' Lambda	Direct Hits	Direct Hits	Wilks' Lambda	Direct Hits	Direct Hits
PSS	.402	10.5%	9.2%	.406	10.1%	9.2%
GOT	.296	12.4%	11.9%	.320	13.1%	11.9%
BIS	.064	28.1%	23.0%	.068	28.7%	21.6%

Men

	Validation (Sample A)		Cross-Validation (Sample B)	Validation (Sample B)		Cross-Validation (Sample A)
	Wilks' Lambda	Direct Hits	Direct Hits	Wilks' Lambda	Direct Hits	Direct Hits
PSS	.442	9.8%	9.9%	.435	10.1%	9.6%
GOT	.348	11.6%	12.1%	.309	13.0%	11.5%
BIS	.068	28.9%	25.2%	.062	29.7%	23.4%

demonstrated by Donnay and Borgen (in press). To evaluate the strength of mean differences between two groups, the effect size is usually the mean difference divided by the pooled standard deviations of the groups. An effect size of 1.0 means the difference between the two groups is one standard deviation. Cohen's standard interprets effect sizes of .2, .5, and .8 as small, medium, and large effects, respectively. These standards are equivalent to 1%, 6%, and 14% of the variance explained. Knowing that one minus lambda equals the proportion of variance explained by group membership, the proportions derived from Cohen's standards are equivalent to lambdas of .99, .94, and .86, respectively. Thus, lambdas of .86 or less represent large effect sizes. Examination of Table 5 shows Wilks' lambda values ranging from .456 (combined-sex Sample A) to .062 (men's Sample B). Given that Cohen's standard would interpret a lambda of .86 or less as a large effect size, these results are highly impressive.

The values for Wilks' lambda showed the predicted increases in concurrent validity across all three predictor sets for all three groups (combined-sex, women, and men). As the number of variables and the specificity of those variables within a predictor set increased, Wilks' lambda reflected an increase in the capacity of the predictor set to differentiate among occupational groups in the multivariate environment. Thus, in the combined-sex sample (Sample B), the Personal

Style Scales accounted for 54.5% of the variance, the General Occupational Themes accounted for 65%, and the Basic Interest Scales accounted for 91.5%. In the women's sample (Sample A), the Personal Style Scales accounted for 59.8% of occupational group differences, the General Occupational Themes accounted for 70.4%, and the Basic Interest Scales accounted for 93.6%. This pattern also appeared in the men's sample (Sample B) where the Personal Style Scales accounted for 56.5% of the variance in occupational group membership, the General Occupational Themes 69.1%, and the Basic Interest Scales 93.8%. It is also important to note that the Personal Style Scales alone account for a substantial proportion of variation among occupational groups, even though they represent the most global of the three predictor sets.

Table 6 permits comparisons to be drawn between the combined-sex sample of 43 gender-balanced occupations selected for the current study and the General Reference Sample of 50 occupations examined by Donnay (1995), and Donnay and Borgen (in press). The reader will recall that the current study eliminated seven occupational groups from the General Reference Sample due to their unequal gender representation: bookkeeper, child care provider, farmer, gardener/groundskeeper, paralegal, plumber, and police officer. The results failed to confirm the hypothesized increase in concurrent validity when only gender-balanced occupational groups are included in the analyses. All three

Table 6. Multivariate predictive power of three predictor sets: Comparison of 43 gender-balanced occupations and the General Reference Sample of 50 occupations (Donnay, 1995)

	43 Gender-Balanced Occupations		General Reference Sample	
	Validation (Sample A)	Cross-Validation (Sample B)	Validation	Cross-Validation
Predictor Set	Wilks' Lambda	Direct Hits	Wilks' Lambda	Direct Hits
PSS	.456	9.6%	.448	8.7%
GOT	.357	11.5%	.346	10.5%
BIS	.086	23.8%	.082	22.2%

of the predictor sets accounted for less of the variance among occupational groups in the present study than they accounted for in the studies by Donnay (1995), and Donnay and Borgen (in press). The differences, however, were small: 0.8% for the Personal Style Scales, 1.1% for the General Occupational Themes, and 0.4% for the Basic Interest Scales.

Table 7 permits ready comparison of the multivariate predictor sets across all three groups examined. The results confirmed the hypothesized increase in concurrent validity (based on the 4% minimum difference standard established earlier) for the Personal Style Scales and the General Occupational Themes when the women's sample was examined separately from the men's and the combined-sex samples. The

Table 7. Multivariate predictive power of three predictor sets: Comparison of combined-sex and single-sex samples

	Combined-sex		Women		Men	
	Validation (Sample A)	Cross-Validation (Sample B)	Validation (Sample A)	Cross-Validation (Sample B)	Validation (Sample A)	Cross-Validation (Sample B)
Predictor Set	Wilks' Lambda	Direct Hits	Wilks' Lambda	Direct Hits	Wilks' Lambda	Direct Hits
PSS	.456	9.6%	.402	9.2%	.442	9.9%
GOT	.357	11.5%	.296	11.9%	.348	12.1%
BIS	.086	23.8%	.064	23.0%	.068	25.2%

Personal Style Scales accounted for 4% more occupational group variance for the women's sample than the men's sample and 5.4% more than for the combined-sex sample. The General Occupational Themes accounted for 5.2% more variance in the women's sample than the men's sample and 6.1% more than the combined-sex sample. The Basic Interest Scales, however, did not show meaningful differences across groups in the amount of occupational group variance for which they accounted.

Table 7 also permits comparison between the women's and men's samples regarding the predictive capacities of the predictor sets. The results failed to confirm the hypothesis that the predictor sets would show greater concurrent validity for men than for women. In fact, the Personal Style Scales and the General Occupational Themes accounted for more of the variance among occupational groups for women (59.8% and 70.4%, respectively) than for men (55.8% and 65.2%, respectively). The difference in percentage of occupational group variance accounted for by the Basic Interest Scales for the women's sample (93.6%) and the men's sample (93.2%) was negligible.

Another useful metric for examining the concurrent validity of the three predictor sets is cross-validation hit rates. Direct hits represent the percentage of times wherein a predictor set provided exact predictions of actual occupational group membership using the discriminant function results. The prior probability of occupational group

membership (base rate) for all three samples was 0.02326, or approximately two percent. The proportion of accurate predictions made using the discriminant results can be compared with the proportion of accurate predictions expected on the basis of chance (Betz, 1987). For example, using the Basic Interest Scales as the predictor set, the hit rate of 23.8% for the combined-sex cross-validation sample was nearly 12 times greater than chance.

Table 6 shows the direct hit rates for the 43 gender-balanced occupations included in the current study and the 50 occupations comprising the General Reference Sample examined by Donnay (1995), and Donnay and Borgen (in press). The results failed to confirm the hypothesized increases in predictive capacity of the three predictor sets when only gender-balanced occupational groups were included in the analyses. The current study found direct hit rates of 9.6% for the Personal Style Scales, 11.5% for the General Occupational Themes, and 23.8% for the Basic Interest Scales, while Donnay, and Donnay and Borgen found direct hit rates of 8.7%, 10.5%, and 22.2%, respectively.

Direct hits for the three sample groups in the current study are summarized in Table 7. The results confirmed the hypothesized increase in predictive capacity of the predictor sets relative to increases in the number and specificity of the variables within each set. Thus, the Basic Interest

Scales produced substantially greater hit rates across all three samples than did the Personal Style Scales or the General Occupational Themes. The difference in predictive capacity between the Personal Style Scales and the General Occupational Themes reached the 2% minimum standard set earlier for the women's and men's samples, but not for the combined-sex sample.

It was hypothesized that the concurrent validity of the predictor sets would be greater for the single-sex samples than for the combined-sex samples. The results confirmed the hypothesized increase only for the women's sample, where the Personal Style Scales and General Occupational Themes accounted for more between-groups variance than they did for the combined-sex sample. There was no corresponding increase in direct hit rates, however. Neither single-sex sample showed improved concurrent validity over the combined-sex sample when the Basic Interest Scales were used as the predictor set.

It was also hypothesized that the predictor sets would show greater concurrent validity for the men's sample than for the women's sample. The direct hit rates shown in Table 7 confirmed this hypothesis only in the case of the Basic Interest Scales where the direct hit rate for the men's sample was 2.2% greater than that found for the women's sample.

Additional between-groups variance accounted for by the

Personal Style Scales, after controlling for the General Occupational Themes and the Basic Interest Scales, was examined through hierarchical discriminant analysis. The results are shown in Table 8. In order to facilitate examination, Table 9 provides a summary of the multivariate analyses.

The values of Wilks' lambda for all three groups showed an increase in between-groups variance accounted for when the Personal Style Scales are united with the General Occupational Themes and the Basic Interest Scales. The difference between the amount of variance accounted for by the General Occupational Themes and Basic Interest Scales, and that accounted for when the Personal Style Scales were used with them did not, however, meet the 4% minimum for practical significance set earlier. Direct hit rates also improved when the three predictor sets were used together, but did not meet the 2% standard for any of the samples. It is interesting to note, however, that the hit rates for the men's sample were greater than those for the women's sample using the Personal Style Scales with the Basic Interest Scales, and the General Occupational Themes with the Basic Interest Scales. Conversely, combining the Personal Style Scales with the General Occupational Themes resulted in a meaningful difference in variance accounted for in the women's sample over that found for the combined-sex sample.

Table 8. Hierarchical discriminant analyses: Between-groups variance accounted for by the Personal Style Scales after controlling for the General Occupational Themes and Basic Interest Scales

Combined-sex sample

	Validation (Sample A)		Cross-Validation (Sample B)	Validation (Sample B)		Cross-Validation (Sample A)
	Wilks' Lambda	Direct Hits	Direct Hits	Wilks' Lambda	Direct Hits	Direct Hits
PSS & GOT	.243	14.9%	15.5%	.232	16.4%	14.3%
PSS & BIS	.072	27.5%	25.0%	.072	27.7%	24.5%
GOT & BIS	.074	27.2%	24.9%	.071	27.7%	24.0%
PSS & GOT & BIS	.063	29.2%	26.0%	.061	29.9%	25.5%

Women

	Validation (Sample A)		Cross-Validation (Sample B)	Validation (Sample B)		Cross-Validation (Sample A)
	Wilks' Lambda	Direct Hits	Direct Hits	Wilks' Lambda	Direct Hits	Direct Hits
PSS & GOT	.196	16.5%	15.9%	.200	17.2%	14.4%
PSS & BIS	.053	30.1%	24.3%	.056	30.4%	23.5%
GOT & BIS	.055	30.0%	23.9%	.056	30.5%	22.9%
PSS & GOT & BIS	.045	32.0%	25.4%	.046	32.0%	24.1%

Table 8. (continued)

Men

	Validation (Sample A)		Cross-Validation (Sample B)	Validation (Sample B)		Cross-Validation (Sample A)
	Wilks' Lambda	Direct Hits	Direct Hits	Wilks' Lambda	Direct Hits	Direct Hits
PSS & GOT	.229	16.6%	15.9%	.224	18.3%	15.0%
PSS & BIS	.055	30.9%	26.3%	.052	31.6%	24.3%
GOT & BIS	.055	31.0%	25.9%	.051	32.0%	24.9%
PSS & GOT & BIS	.046	32.7%	27.0%	.043	34.0%	26.5%

Table 9. Multivariate prediction: Comparison of predictor sets, individually and in combination, for combined-sex and single-sex samples

	Combined-sex		Women		Men	
	Validation (Sample A)	Cross-Validation (Sample B)	Validation (Sample A)	Cross-Validation (Sample B)	Validation (Sample A)	Cross-Validation (Sample B)
Predictor Set	Wilks' Lambda	Direct Hits	Wilks' Lambda	Direct Hits	Wilks' Lambda	Direct Hits
PSS	.456	9.6%	.402	9.2%	.442	9.9%
GOT	.357	11.5%	.296	11.9%	.348	12.1%
BIS	.086	23.8%	.064	23.0%	.068	25.2%
PSS & GOT	.243	15.5%	.196	15.9%	.229	15.9%
PSS & BIS	.072	25.0%	.053	24.3%	.055	26.3%
GOT & BIS	.074	24.9%	.055	23.9%	.055	25.9%
PSS & GOT & BIS	.063	26.0%	.045	25.4%	.046	27.0%

Summary of Results

The results of the univariate analyses indicated each of the 35 variables (scales) considered here made substantial contributions to occupational group separation for all three groups: the combined-sex, women's, and men's samples.

Results of the multivariate analyses (see Figure 1) supported the hypothesis for all three groups that concurrent validity would increase as predictor sets increased in both the number and specificity of the variables they contained. The expected increases were evident in terms of both the

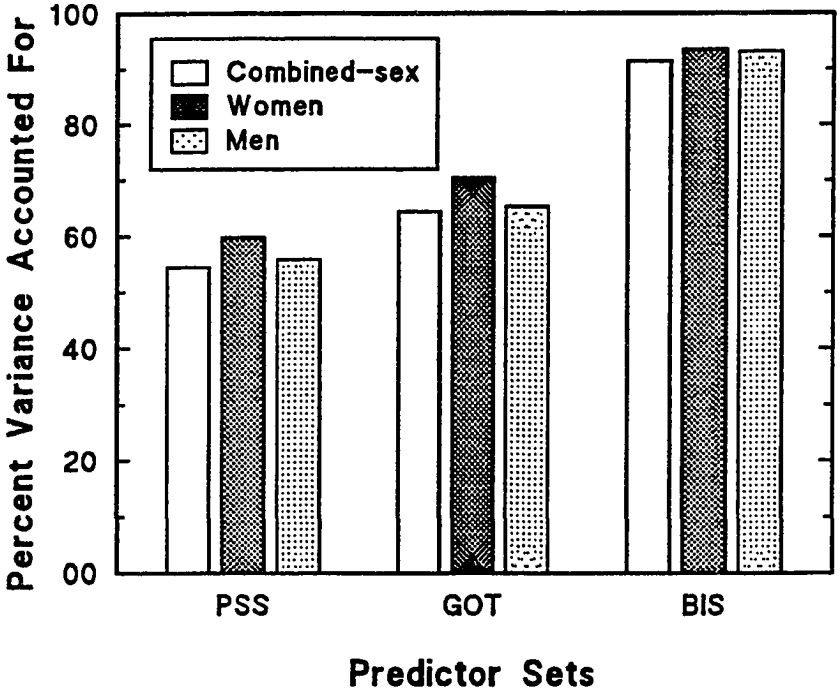

Figure 1. Proportion of occupational group variance explained by three predictor sets across three samples

proportion of variance explained and the percentage of direct hits.

This study examined concurrent validity of the Strong using the 43 occupational groups in the General Reference Sample where equal numbers of women and men were represented, while Donnay (1995), and Donnay and Borgen (in press) examined all 50 occupational groups from the same sample. Comparison of between-groups variance accounted for and direct hit rates for the two studies revealed no practical improvement in concurrent validity when only gender-balanced occupational groups were included in the samples.

When the power of the predictor sets for the combined-sex sample was compared with that found for the single-sex samples, the proportion of variance accounted for in the women's sample confirmed the hypothesized increases for the Personal Style Scales and General Occupational Themes, but not the Basic Interest Scales. Equivalent increases for the men's sample were not found. Neither single-sex sample showed meaningful improvement in direct hit rates over those found for the combined-sex sample.

Drawing comparisons between the two single-sex samples, only the direct hit rate for the Basic Interest Scales supported the hypothesis that concurrent validity would be greater for the men's sample than for the women's sample. Contrary to expectations, the proportion of occupational group

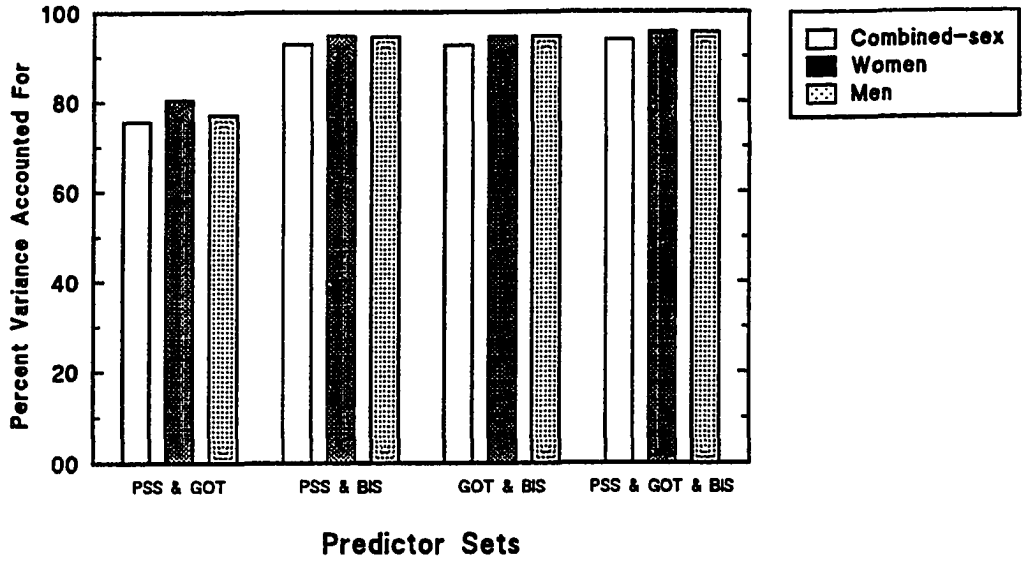

Figure 2. Proportion of occupational group variance explained by predictor set combinations across three samples

variance accounted for by the Personal Style Scales and General Occupational Themes was greater for the women's sample than for the men's sample.

Results of the hierarchical discriminant analyses (see Figure 2) showed no practical increase in predictive power when the Personal Style Scales were used in concert with the General Occupational Themes and Basic Interest Scales. However, combining the Personal Style Scales with the General Occupational Themes accounted for more group variance in the women's sample than in the combined-sex sample. Uniting the

Basic Interest Scales with either the Personal Style Scales or the General Occupational Themes yielded higher direct hit rates for the men's sample than for the women's sample.

DISCUSSION

This study used discriminant function analysis to investigate gender differences in the concurrent validity of the 1994 Strong Interest Inventory using the Personal Style Scales, General Occupational Themes, and Basic Interest Scales as predictor sets. Comparisons were drawn between the sets' predictive power for the full General Reference Sample [as reported by Donnay (1995) and Donnay & Borgen (in press)] and for a subset composed of 43 gender-balanced occupations taken from the General Reference Sample. The gender-balanced occupational sample was then separated by gender and the multivariate technique used to investigate differences by gender in the concurrent validity of the predictor sets. Finally, hierarchical discriminant analysis was used to identify the contribution to occupational group separation made by the 1994 Strong's newly-incorporated Personal Style Scales after controlling for the contributions of the General Occupational Themes and Basic Interest Scales.

The central questions addressed here, through the use of the multivariate technique, concern the extent to which the Personal Style Scales, the General Occupational Themes, and the Basic Interest Scales predict occupational group membership and whether they accomplish that goal more effectively for one sex than the other. The results indicate all three predictor sets (Personal Style Scales, General

Occupational Themes, and Basic Interest Scales) are powerful in their capacity to distinguish among occupational groups on the basis of interest patterns. This holds true for the combined-sex sample, the women's sample, and the men's sample. The Basic Interest Scales form the best predictor set. This finding is consistent with the expectation that the set containing both the greatest number of variables and the most specific variables will most accurately predict occupational group membership. The concurrent validity of each of the remaining predictor sets is also substantial. Considering that the General Occupational Themes address broad fields of interest and the Personal Style Scales are even more global in scope, their contributions to differentiating among occupational groups in the multivariate environment are remarkable.

The results of the univariate analyses confirm that all 35 of the Strong scales considered make significant contributions to occupational group separation for all three groups of participants; the combined-sex group, the women's group, and the men's group. The greatest single contribution among all 35 scales, as well as among the Personal Style Scales, is made by the Work Style scale for all three groups. This finding supports the centrality of the persons-things dimension noted by others (e.g., Rounds & Tracey, 1993). Among the General Occupational Themes, the Investigative scale

contributes most to differentiating among occupational groups for all three samples. The prominence of the Investigative theme is consistent with the science-nonscience distinction drawn by Borgen (1972). The centrality of the science-nonscience dimension is echoed in the preeminence of the Science Basic Interest Scale for the combined-sex and women's samples. In the men's group, however, the Science scale contributes most to occupational group separation for Sample A, while in Sample B that distinction is shared among the Science, Medical Service, and Organizational Management scales. While it is not clear why this difference occurred, it may be speculated that the three scales share a common denominator reflecting interest in, for example, involvement with facilities such as hospitals and clinics that provide science-based services.

Comparisons were drawn between the 43 gender-balanced occupational groups used here and the 50 occupational groups of the General Reference Sample (Donnay, 1995; Donnay & Borgen, in press). The results show no practical improvement in the concurrent validity of the predictor sets when occupational groups that do not include equal numbers of women and men are eliminated from the sample. The inclusion of occupational groups underrepresenting one sex or the other does not alter the robustness of the measure. The most parsimonious explanation for these findings may be that the

interests of the seven occupational groups excluded from the analyses are represented by other, related occupational groups that remain in the sample.

When the effect sizes for the predictor sets are compared across the three groups, a clear improvement in the amount of occupational group variation explained emerges for the women's sample. The Personal Style Scales and the General Occupational Themes account for a greater proportion of variance for women than for either the combined-sex sample or the men's sample. The results suggest the Personal Style Scales and the General Occupational Themes capture the distinguishing characteristics of occupational group membership more effectively for women than they do for men. This advantage is obscured when women and men are grouped together. Such differences across groups were not found for the Basic Interest Scales and probably reflects their substantially greater predictive capacity. Examination of direct hit rates reveals the Basic Interest Scales predict occupational group membership better for men than for women. The practical significance of this difference is not clear.

All of the Strong scales included in this study demonstrate a capacity for predicting occupational group membership that is several times greater than the base rate. While exceeding chance does not mean perfect prediction, it is important to remember that the direct hit percentages reported

here reflect only those instances in which a set of scales produced an exact match between predicted and actual occupational group from among the 43 possible occupational groups. Indirect hits, where job family rather than exact occupational group would be predicted, were not identified by the techniques used in this study. If the percentage of direct and indirect hits was determined, the proportion of participants correctly classified would likely be far greater. Despite the demanding criterion that only exact occupational group membership identification be included in hit rate percentages, the results of this study show hit rates ranging from 4 to 12 times greater than chance.

The ascendency of the Work Style Scale in contributing to occupational group separation is especially noteworthy considering that both the scale and several of the items on it are new additions to the Strong. The information it provides to counselors and their clients will be particularly useful in helping make sense of seemingly contradictory results. Clients who, for example, score highest on the Science and Organizational Management Basic Interest Scales, may find satisfaction in careers such as hospital administration or research institution management.

The other three Personal Style Scales also provide important information for clients, information that extends beyond the world of work. While clients often recognize

themselves quite easily in their profiles, the Personal Style Scales organize this information in new ways. Clients can apply this structure to making choices not only about how they work, but about how they learn, play, and conduct their lives. Knowledge of such stylistic preferences is consistent with one of the goals of counseling, increasing self-understanding.

The results of the hierarchical discriminant analyses indicate that combining the Personal Style Scales with the General Occupational Themes and Basic Interest Scales increases the proportion of occupational group variance accounted for over that found when only the General Occupational Themes and Basic Interest Scales are considered. This improvement is demonstrated for the combined-sex sample, the women's sample, and the men's sample. This finding suggests the Personal Style Scales amplify the explanatory power of the other two predictor sets. It is also interesting to note that combining the Personal Style Scales with the General Occupational Themes results in an increase in the proportion of occupational group variance accounted for in the women's sample over that accounted for in either the combined-sex sample or the men's sample. This finding suggests the Personal Style Scales capture features of variation in occupational group membership that are more salient for women than for men and that may be obscured when the sexes are analyzed together.

Examination of direct hit rates suggests that combining the Personal Style Scales with the General Occupational Themes and Basic Interest Scales enhances identification of occupational group membership. It is also interesting to note that two of the predictor set pairs show direct hit rates that are greater for the men's sample than for the women's sample. In each case, the difference in direct hit rate meets the standard for practical difference used in this study. The Personal Style Scales-Basic Interest Scales and the General Occupational Themes-Basic Interest Scales predictor set pairs show greater direct hit rates for the men's sample than for the women's sample. The reason for this difference is not clear.

The Personal Style Scales are an innovative enhancement of the Strong's effectiveness in discriminating among occupational groups in the mulitvariate environment. Furthermore, their inclusion invites future researchers to investigate more fully the relationships among personality characteristics and occupational group membership.

The reader will recall that several pioneers in the field of vocational interest measurement, including Hogg (1928), Manson (1931), and E. K. Strong (1933, 1943), concluded that women's vocational interests were not sufficiently differentiated, for most occupations, to make them useful in distinguishing among occupational groups. The results of this

study, however, indicate the 1994 revision of the Strong has successfully met the challenge of identifying characteristic occupational group interest patterns for both women and men. This accomplishment is probably both a testimony to the vigor of the Strong and a reflection of women's expanding roles and involvement in the world of work.

The results also indicate that, while some investigators (e.g., Gaeddert & Hansen, 1993) have suggested that women's interests may be more diverse than men's, the Strong is effective for both women and men in relating interest patterns to occupational group membership. In other words, occupational space is so well differentiated that people in different occupations are demonstrably distinct from one another in their interest patterns and the Strong successfully reflects those differences.

Clearly, all the scales of the 1994 Strong are powerful, delivering valuable information to counselors and clients. The anticipated sex differences in concurrent validity for the predictor sets did not materialize from the findings of this study. Users can have confidence in the predictive power of the scales examined here for their applicability to both women and men.

Counseling Implications

The results of this study indicate the Strong is psychometrically equivalent for women and men in its capacity

for relating interest patterns to occupational group membership. While this is reassuring for users of the Strong, questions remain regarding the underrepresentation of women in traditionally male-dominated occupations. A case in point is that of plumbers, one of the seven occupational groups not included in the analyses due to a lack of data on women plumbers. A recent conversation with the training director of the local plumbers and steamfitters union apprenticeship program revealed that, nationwide, only 3% of the women who begin the 5-year apprenticeship complete it. The reasons for such a high rate of attrition are not clear. The training director speculated that the type of work or the working conditions plumbers face might be the cause. Other possibilities include the lack of support for working in a nontraditional occupation, the lack of female role models, and the difficulties associated with meeting parenting responsibilities, if the apprentice is a single parent as many women are, while participating in a training program that involves a full work week followed by class work all day Saturday.

Yet another potential explanation, especially salient to users of the Strong, is a lack of exposure to activities that would be relevant to plumbing, or other nontraditional occupations for women. If interests are, as Strong (1943) noted, learned expressions of liking an area, then it is

necessary to have experience with that area before deciding whether or not interest is present. Clients cannot know if they have interests in activities to which they have not been exposed. It is, therefore, the task of the counselor to facilitate clients in opening career possibilities heretofore not considered, exploring the extent of their interests in those areas, and recognizing the barriers that have helped to shape their interests. Women's potential interests in nontraditional careers are unlikely to be recognized, let alone explored and cultivated. Counselors have a responsibility to help clients "restore options" (Betz, 1989) so that their career choices are based on knowledge of their interests, both nascent and established.

A wealth of information about interests is provided in the Strong profile and can be used to explore career options that might not otherwise be considered. The operative word here is "explore." In probing the depths of their clients' profiles, counselors can help them consider not only those occupations to which their interests are most similar, but also those in which they have an average degree of shared interests. Helping clients question the reasons for their moderate scores opens discussion about the influence of gender role socialization, family expectations and pressures, absence or presence of role models, opportunities to observe or participate in activities specific to occupations, and

barriers to preparing for entry into occupations. Such exploration is particularly important when clients express moderate levels of interest in sex-stereotyped occupations. Counselors can help clients increase self-knowledge by examining the external limitations that may have been imposed upon them, constraining their opportunities to more fully appreciate the range of their interests. Exploration of this kind will lead to opening new career paths for some clients and confirming genuine absence of interest, or limited interest, for others. Either way, career decision-making will be more fully informed.

Betz (1989, 1993) is an especially strong proponent of the exploratory approach to career counseling. She recommends helping clients examine not only their beliefs about gender-appropriate career options, but also those areas in which they may have developed some degree of interest <u>despite</u> the pressures of socialization. This can be readily accomplished by examining clients' <u>Strong</u> scores relative to both same-sex and opposite-sex reference groups (Harmon et al., 1994). Discussing the development of interests for which clients have received little or no cultural support can be particularly fruitful for enhancing self-knowledge.

Successful career counseling also requires that counselors be sensitive to their own beliefs and values regarding women's and men's roles in the world of work

(Forrest & Brooks, 1993; Fouad & Spreda, 1995; Hackett & Lonborg, 1993). Honest examination of their beliefs, expectations, stereotypes, and value systems will help counselors avoid both errors of commission and the more subtle errors of omission that could limit the career options clients consider. It is important to remember that counselors, too, face the same social pressures impinging on their clients.

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